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EDITORIAL COMMENT

Should an Alternate ABI Definition Be Adopted to Evaluate Risk?*

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The ankle-brachial index (ABI) is the ratio of the systolic blood pressure measured at the ankle divided by the systolic blood pressure at the arm. By convention, the highest of the 2 arm pressures and the highest of the dorsalis pedis or posterior tibial artery pressures at the ankle are used to form the calculation, with peripheral artery disease (PAD) identified at a threshold of an ABI $\leq$0.90 in either leg (the index leg would have the lowest ABI) (1). The ABI essentially measures the hemodynamic severity of occlusive disease in the lower extremity. Thus, the measure would miss early atherosclerotic lesions, because an abnormal ABI is dependent upon a pressure drop across a significant arterial stenosis or occlusion to reduce the pressure at the ankle. A lower ABI value is associated with greater hemodynamic disease burden

See page 553

usually involving multiple occlusions between the aorta and the tibial vessels.

The historical utility of the ABI has been as the primary noninvasive means to diagnose PAD in the setting of evaluating patients with limb signs or symptoms suggestive of PAD. In patients with an isolated, proximal iliac stenosis who have a normal ABI, an exercise test is often employed to bring out the hemodynamic abnormality. In this setting an abnormal ABI in conjunction with an appropriate consolation of symptoms would lead to a cascade of interventions to treat those symptoms. This could range from general measures to treat the underlying atherosclerosis of the patient to a formal exercise program, claudication medications, or re-vascularization to relieve the symptoms. Patients with critical limb ischemia have significant hemodynamic compromise and usually move straight to revascularization (2). However, the U.S. Preventive Services Task Force recommends against screening asymptomatic subjects for PAD because of concerns about false positive results and unnecessary evaluations (3). In contrast, the American College of Cardiology Foundation/American Heart Association guidelines for PAD provide a Class 1b recommendation for ABI screening in subjects at risk for PAD (4).

More recently, the ABI has been identified as a measure that aids in risk assessment and prediction of cardiovascular events (5). Patients with PAD have a systemic disorder that is highly correlated with coronary and carotid artery disease with associated increased risk of myocardial infarction, stroke, and vascular death. When applied as a risk prediction tool, an ABI <1.00 is associated with an increase in cardiovascular risk that is progressively magnified at lower ABI values. When evaluated across a number of epidemiologic studies and in the context of a clinical Framingham risk score, an abnormal ABI was able to re-classify the risk category and risk recommendations in 19% of men and 36% of women (5). Thus, the ABI provided independent information over and above a clinical cardiovascular risk score.

As noted in the preceding text, the calculation of ABI has been generally based on assessing the higher of the 2 ankle pressures. The logic is to estimate the highest perfusion pressure in the limb and also to avoid over-diagnosis particularly if the higher value is in the normal range and the lower ankle pressure value is abnormal. In that setting the patient might have isolated tibial disease, which might not be symptomatic. However, a recent scientific statement from the American Heart Association did recommend considering the lower of the 2 pressures as perhaps a better method to risk-stratify individuals (1).

In this context, the study by Nead et al. (6) in this issue of the *Journal* provides critical new information on the prognostic value of an alternative method to calculate the ABI. This investigation was conducted across 2 academic institutions; patients were recruited who were undergoing an elective nonemergent coronary angiogram for evaluating cardiac symptoms. In these subjects the ABI was determined from both the higher and the lower of the ankle pressures, deriving a traditional (higher) and alternative (lower) ABI value, and patients were followed for subsequent cardiovascular events. The results demonstrated that approximately 16% of this referral population had an abnormal ABI by the traditional measure; however, an additional 21% had an abnormal ABI by the alternative calculation (these were mutually exclusive populations). An abnormal ABI by the alternative method would imply that those subjects had isolated tibial artery disease, because the higher pressure of the 2 tibial vessels would have resulted in an ABI in the normal range. When followed for cardiovascular outcomes, both methods had similar diagnostic and predictive accuracy for all-cause and cardiovascular mortality with similar hazard ratios between the methods. However, the C-index suggested slightly better diagnostic characteristics for the alternative method predicting cardiovascular mortality. But the primary message is that the alternative method identified

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a group of individuals who would otherwise not be considered at risk on the basis of the finding that their traditional ABI was normal. Therefore, the main utility of the alternate method is to identify an additional at-risk population for cardiovascular events that would have otherwise been missed.

These findings are provocative and could potentially change our approach to calculating the ABI when used as an index of cardiovascular risk. However, the findings are limited, because this was a referral population primarily evaluated for potential coronary disease, and the vast majority of subjects were also identified as having underlying coronary disease. Confirmatory studies on the alternative ABI calculation would need to be performed in broader populations.

The implication of these findings is that an abnormal ABI calculation in either extremity with the lower of the tibial vessel pressures seems to be highly correlated with increased cardiovascular risk and mortality. Therefore, in the context of using the ABI as an objective measure to identify subclinical atherosclerosis, even isolated tibial occlusive disease is highly correlated with adverse cardiovascular outcomes. This finding could significantly broaden the utility of the ABI as a risk stratification measure.

Perhaps more important is the general perception of the utility of the ABI. As noted in the preceding text, the U.S. Preventive Services Task Force recommends against ABI screening of asymptomatic populations for concern that the information would lead to inappropriate work-up and excessive use of peripheral procedures (despite no data to support this concern). In contrast, cardiovascular guidelines (TransAtlantic Inter-Society Concensus and American College of Cardiology Foundation/American Heart Association) provide a strong recommendation for ABI screening. The current study further confirms the importance of measuring peripheral hemodynamic status and assessing populations at potential risk to further refine their risk prediction and also appropriately target risk reduction interventions. A limitation of the ABI is that its utility has not been formally tested in a randomized controlled trial with a design that uses ABI as the entry point to assess outcomes. However, in the absence of this information, the current utility as a risk prediction tool is certainly well-established, and that utility has been further validated by the current study.

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